Art. VI.—*Notes on a Simplification of a Photographic Process used with Self-registering Instruments.*

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Since the adoption of photography as a means for obtaining continuous and automatic records of magnetic meteorological and other phenomena, the observatory work in those branches of physical science has undergone almost a complete revolution. A fair knowledge of the theory and practice of photography has now become essential to the observer, and no public observatory of any pretensions can be considered complete without its photographic room.

The photographic method of registration was first adopted in our observatory in August, 1867, in connection with an instrument (which I have already described) for measuring the force and variations of atmospheric electricity, and subsequently for the magnetic instruments, the self-registering barometer, and lately also for wet and dry bulb thermometers. At the present time about 20 sheets (6 inches by 13 inches) are prepared, developed, and finally treated every week. *Artificial light,* either from gas, oil, or kerosene, is always used in this kind of photography—in our observatory the former is used.

The instruments are so arranged that the light, from a peculiar kind of burner, falls on to mirrors affixed to the movable and sensitive parts of the apparatus, or passes through transparent spaces which move with the indicators of the particular instrument, after which it is focussed or condensed, so as to fall on to the photographic paper in the form of an intense dot or line of light. In the Electrographs and Magnetographs, the light first passes through a narrow slit and an achromatic lens, then falls on to the mirror, which reflects it as a line of light towards a cylinder, around which the sensitive paper is fixed; it is intercepted, however, by a cylindrical lens, which converges the *line* of light to a *dot* on the paper. As the mirror moves with the magnets or electrograph pendulum the dot will fall on different parts of the cylinder, which is caused to revolve once in 24 or 48 hours by clockwork—a curve or crooked line is therefore traced on the paper, showing the deviation of the magnets, &c., in the 24 or 48 hours. In the Barograph the light passing through the vacuum above the Mercury Column, is converged to a sharp line on the cylinder, and is elongated or shortened as the mercury rises or falls; in the Thermographs

it passes through a small air space in the mercury of the thermometers, and by means of lenses a bright image of this space is focussed on to the cylinder. The photographic results obtained are simple, consisting of straight or curved lines, or a regularly blackened surface without toning or shading of any kind, as will be seen by specimens on the table.

It is, however, merely to the methods of preparing the sensitive paper that I wish to direct your attention to-night. At first the method we adopted was that known as Crooke's modification of the old wax-paper process of Gray; a modification arrived at after considerable experiment to ascertain what particular salts of silver, and their proportion, would be most sensitive to ordinary artificial lights. The method is fully described in the British Association report of 1859, and was that subsequently adopted at the observatories at Kew and Oxford. In this process the paper is first soaked in melted wax, and superfluous wax afterwards removed by hot pressing. By this means it was intended to give the paper a closer and smoother surface, and also to render it transparent, so that copies of any pictures or impressions on it might be photographically obtained.

The paper thus prepared and cut to the proper size is immersed in a bath composed of proper proportions of Iodide and Bromide of Potassium, with enough free Iodine added to render the solution of a port wine colour. After immersion for several hours in this bath the paper becomes of a dark reddish brown, and can be kept in this state for almost any length of time. The next part of the process is to render the paper sensitive to the action of light, which is accomplished by floating them in a bath of Acetic Nitrate of Silver on which, after a few minutes, they become of the delicate straw colour of Iodide and Bromide of Silver; in this state they can be preserved in the dark for some days without much deterioration, but in practice they seldom keep so much as a week before using. It is in this condition they are placed upon the cylinders for registering.

When removed from the cylinder, after the 24 or 48 hours' exposure to the dots or lines of light, the paper appears just the same as when placed upon them, no impression is visible till after the next process, *development*. This is done by floating them upon a solution of Gallic Acid with Nitrate of Silver and Acetic Acid [a film of which is poured on an accurately levelled sheet of plate-glass], for a period of time varying from two to three hours, depending on the tempera-

ture, when the trace of the dots of light appear as black lines more or less, or as a blackened surface in the case of Barograph. It only now remains to dissolve out the unchanged Iodide of Silver by Hyposulphate of Soda, and thoroughly free the papers from every trace of the latter salt by washing, and the registers are complete.

In this process many precautions are requisite; in the different stages of preparing the paper they are the same as must always be observed in photography; and the development especially requires great care. To secure good evenly waxed papers in the first place was found with us to be no easy matter, and required considerable time and frequent hot pressings, care being taken that the temperature was not higher than 212°. With every precaution, however, dark or spotted papers frequently resulted with us, and we seldom got a paper that, after fixing, returned any of its pristine whiteness on the unaffected parts.

Frequent comparative failures of this kind led me to experiment, especially to obtain similar conditions of paper by other materials than wax, and I found by far the best result was got by using paraffin. The process was easier and quicker, the papers were cleaner and of a better colour, and best of all, the time occupied in the various processes of sensitizing, developing, &c., was very much shortened.

Paraffin has a lower melting point than wax, consequently it can be kept fluid more easily, it permeates the paper much quicker and more evenly, and one or two pressings in the hot press are sufficient to get rid of all superfluous paraffin, and render the whole batch nicely and evenly translucent. Both —waxing and paraffining papers—are done by having a tin tray (large enough to hold a full sheet of photo-paper) fitted on to a large water-bath; in this tray the wax or paraffin is melted and the papers dipped. A pile of paper is then made up by placing one waxed or paraffined between six or seven plain, and in the hot press the whole becomes evenly saturated.

Paraffin has the advantage over wax on many other points: it is less sticky, the papers can therefore be separated more easily after coming from the press, and very few are torn; they are also less greasy, and take the baths more quickly and evenly, and when prepared are decidedly more sensitive.

A few modifications in the preparation were suggested. By experience it was found better to use a larger quantity of free iodine in iodizing the papers, and not quite so strong a

developer, otherwise the process was exactly similar to Mr. Crooke's.

Some time since it occurred to me that, as one of the reasons for waxing the papers was to obtain a good surface, and that the paper we now obtain has such an excellent surface, it was quite probable, so far as that particular object was concerned, the waxing or paraffining might be dispensed with; and further, that any necessity for leaving the papers translucent for copying was rather the exception than the rule; and if it were desirable to copy any, those particular ones could be paraffined at any time, or reduced copies could be obtained by the ordinary Collodion process. I therefore tried paper plain and simple, with results excelling those with paraffin; every part of the process was shortened considerably; the percentage of defective papers was again greatly lessened, the records are whiter and clearer, and the time and trouble of the first preparation, which even in the case of paraffin was considerable, is done away with altogether.

The time occupied in the different processes is here set down, and as in these days "time is money," the saving is worthy of note.:

	Iodizing.	Sensitizing.	Developing.
Wax . .	4 hours.	20 minutes	$2\frac{1}{2}$ hours.
Paraffin .	4 ,,	10 ,,	$1\frac{1}{2}$,,
Plain . .	2 ,,	5 ,,	40 min.

Therefore the saving of time by using plain paper instead of waxed, taking into consideration that part of the process can be done by the batch, and others by the single papers only, will be at least 30 minutes for each paper, or 10 hours per week. I have here some samples of the different kind of paper before and after using; also, of the records obtained from the several instruments now in use at the Observatory. The importance of any simplification of the photographic methods used by those engaged in practical and experimental science will I am sure be so fully appreciated by them, that no apology on my part will be necessary for occupying your attention with apparently so trivial a matter.